

# Update: Water Quality & Habitat Conditions Town of Eastham



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# Topics

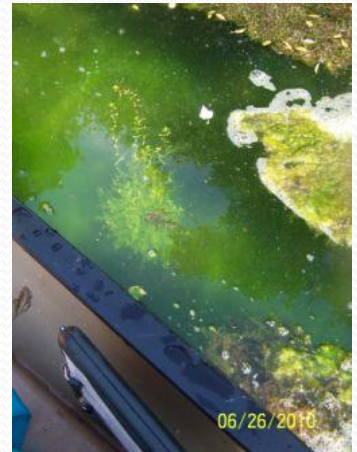
1. Updated status of kettle ponds
2. Salt Pond status
3. Restoration alternatives for Minister/Schoolhouse
4. Discussion

# Status Update

Inland Kettle Ponds

# 2011 Ponds Action Plan with GHD

- Evaluate current conditions and trends
- Screen alternatives
- With community input, define criteria for setting priorities
- Outline path to implementation



# Phosphorus Levels are Key to Pond Health

Total Phosphorus	Attributes	Fisheries and Recreation
6 – 12 ppb	Clear water, well oxygenated	Cold water fishery
12 – 24 ppb	Shallow lakes may become anoxic, water moderately clear	Transitional fishery
24 – 96 ppb	Deep water anoxia Diminished clarity More plants	Less suitable for contact recreation, warm water fishery
96 – 192 ppb	Persistent algal blooms, Anoxia	Unattractive for recreation Harmful algal blooms Fish kills possible



# Test Results: 2011 Action Plan

	Bridge	Depot	Great	Herring	Jemima	Little Deport	Minister	Molls	Muddy	Schoolhouse	Widow Harding
Dissolved Oxygen (>4 mg/L)					✓	✓			✓		✓
Water Clarity (>2 m)	✓	✓	✓		✓			✓			✓
Phosphorus (<10 µg/L)		✓	✓								
Chlor-a (<8 µg/L)	✓	✓	✓				✓		✓		✓
<b>Count</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>3</b>

Sources: PALS, Cape Cod National Seashore data, maintained by Town of Eastham, Eichner 2009 Pond Study

# Criteria to Set Remedial Priorities

- Science-based
  - Current water quality conditions
  - Trends
- Policy considerations
  - Regulatory designation of use attainment
  - Ownership and access
  - Size
  - Treatment history

# Ranking Factors

Criteria	1	2	3
<b>Algal Abundance</b>	Avg. Chlorophyll <8 µg/L	Avg. Chlorophyll 8 – 15 µg/L	Avg. Chlorophyll >15 µg/L
<b>Regulatory Status*</b> <b>(recommended addition)</b>	Use Attainment	Threatened	303(d)- TMDL
<b>Projected Future</b>	Improving	Stable	Declining
<b>Ownership</b>	Private	Mix: private and public	Public
<b>Access</b>	None	Limited	Public beach or launch site
<b>Size</b>	Less than 5 acres	5 – 10 acres	Larger than 10 acres (a Great Pond)
<b>Previously treated by Town</b>	Yes, within 5 years	Yes, within 10 years	Never



# Prioritization

Pond	2011 Priority
Bridge	Low
Depot	Medium
Little Depot	Medium
<b>Great</b>	High
<b>Herring</b>	High
Jemima	Medium
<b>Minister</b>	High
Molls	Low
Muddy	Medium
<b>Schoolhouse</b>	High
Widow Harding	Low

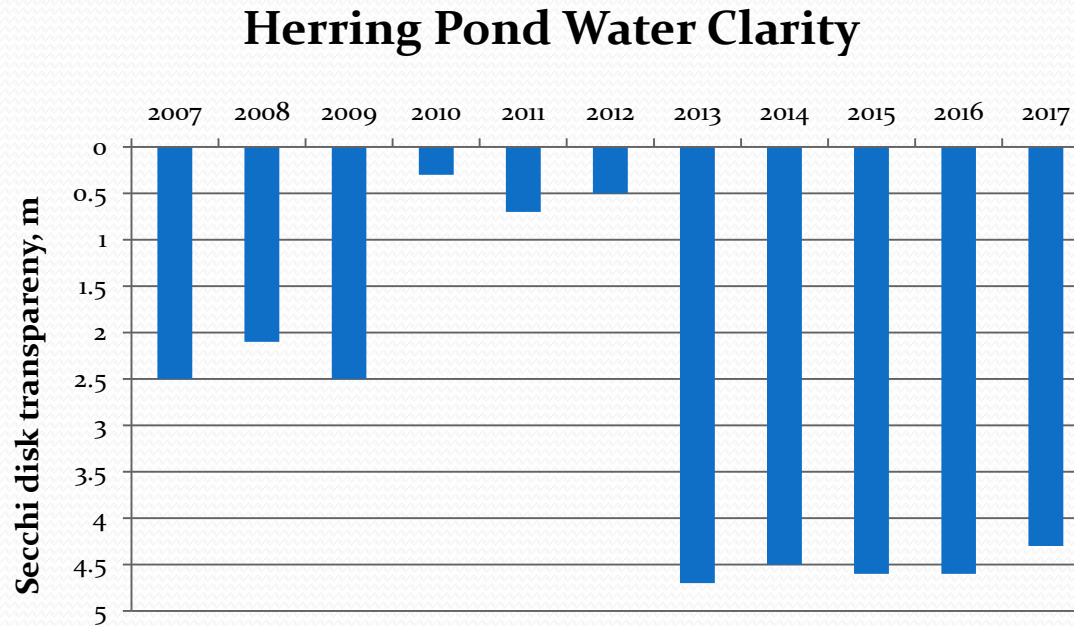
# Alternative Screening

- Addresses the specific impairment
- Likelihood of success/ track record on Cape Cod
- Duration of effectiveness (longevity)
- Relative cost, benefit and risks
- Potential impacts on human & ecosystem health
- Outlook for permitting
- Community acceptance

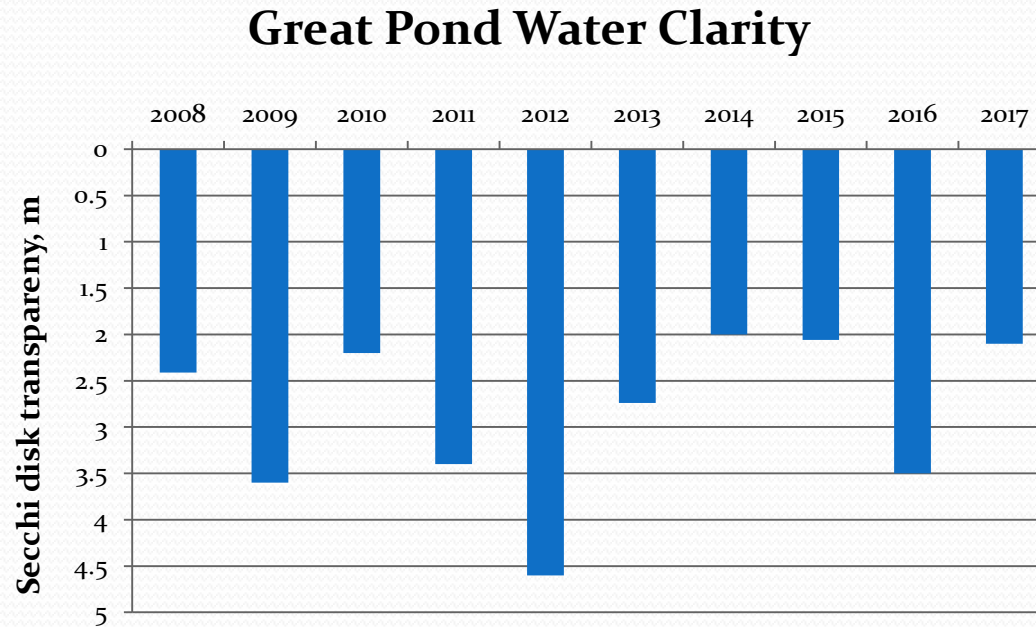
# Alum Treatment Program

	Treatment Area		Treatment Dose	
	Acres	% of Pond	g/m <sup>2</sup>	max, mg/L
Herring	19.8	45.2	75	5
Great	27.7	25.1	25	5

# Herring Pond: response to alum treatment program in Fall 2012



# Great Pond: response to alum treatment program in Fall 2013



# A closer look at the data...

Great Pond	Total P- upper µg/L	Total P- lower µg/L	Minimum DO, mg/L	Chlor-a, µg/L	Secchi Disk, m
2011-2017	16.3	52.4	0.2	3.6	2.9
(pre) 2011-2013	19.6	83.2	0.2	2.9	3.6
(post) 2014-2017	14.6	29.3	0.2	4.2	2.4
Herring Pond	Total P- upper µg/L	Total P- lower µg/L	Minimum DO, mg/L	Chlor-a, µg/L	Secchi Disk, m
2011-2017	17.4	236.2	1.1	8.2	3.3
(pre) 2011-2012	30.3	776.2	0.4	23.5	0.6
(post) 2013-2017	12.2	20.1	1.5	2.0	4.4

# Test Results: 2018 Update

	Bridge	Depot	Great	Herring	Jemima	Little Deport	Minister	Molls	Muddy	Schoolhouse	Widow Harding
Dissolved Oxygen (>4 mg/L)					✓	✓		✓	✓		✓
Water Clarity (>2m)	✓	✓	✓	✓	✓			✓			
Phosphorus (<10 µg/L)											
Chlorophyll (<8 µg/L)	✓	✓	✓	✓	✓		✓		✓	✓	✓
<b>Count</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>

Sources: PALS, Cape Cod National Seashore data, maintained by Town of Eastham

# Water Quality Trends

Stable	Improving	Declining
Bridge	Herring	Depot
Great		Widow Harding (slight)
Jemima		Molls (HAB)
Little Depot		Minister (macrophytes)
Muddy		Schoolhouse (macrophytes)



# Remedial Measures

Technique	Suitability	Consider For
Alum treatment program	Stratified ponds, excessive algae, internal P a major component of budget, iron-rich sediments	Minister Schoolhouse Depot
Oxygenation	Small ponds with transient DO depletion, excessive algae	Little Depot Minister Schoolhouse
Watershed BMPs	Ponds affected by development	All ponds
Dredging (nearshore areas)	Ponds impaired by loss of depth, emergent vegetation	Muddy Minister Schoolhouse

# Draft 2016 Impaired Waters

- Category 2: Unassessed
  - Herring Pond
  - Depot Pond
- Category 5: TMDL required
  - Great Pond
    - Elevated chlorophyll-a, total P
    - Low dissolved oxygen
  - Molls Pond
    - Harmful Algal Bloom

# Updated Prioritization

Pond	2011 Priority	2018 Priority
Bridge	Low	Low
<b>Depot</b>	Medium	Medium-High?
Little Depot	Medium	Medium
<b>Great</b>	High	Medium-303(d)
<b>Herring</b>	High	Low
Jemima	Medium	Medium
<b>Minister</b>	<b>High</b>	<b>High</b>
<b>Molls</b>	Low	Medium-303(d)
Muddy	Medium	Medium
<b>Schoolhouse</b>	<b>High</b>	<b>High</b>
Widow Harding	Low	Low

# Status Update

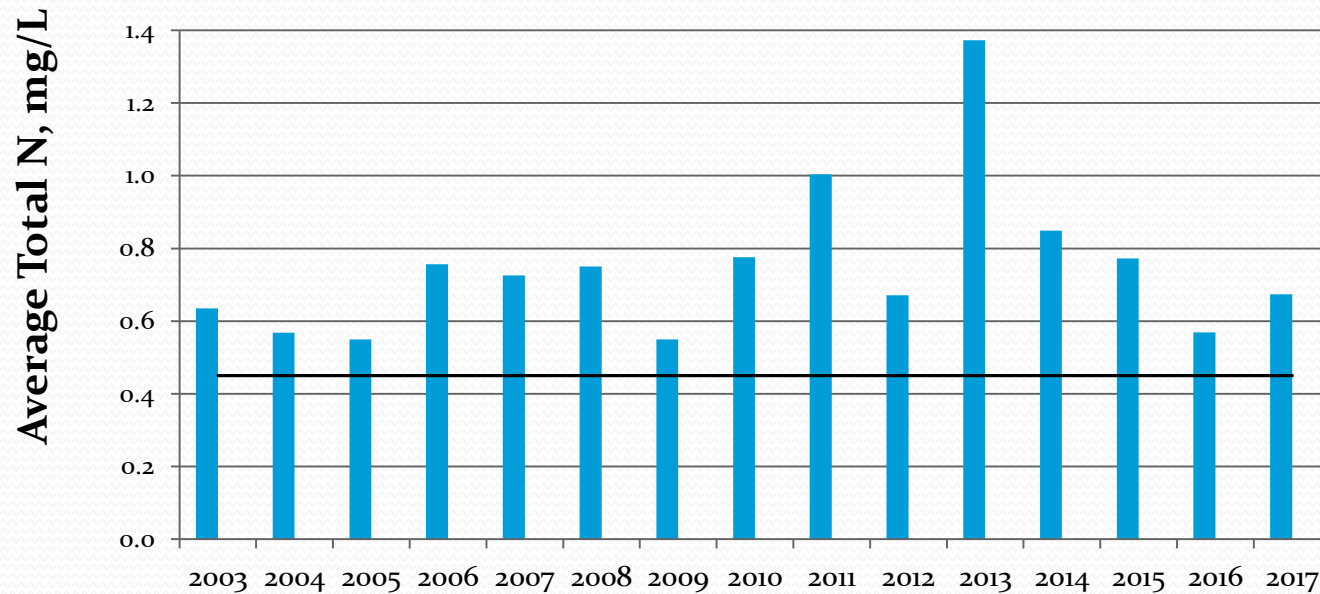
Salt Pond

# Nitrogen TMDL for Nauset Estuary

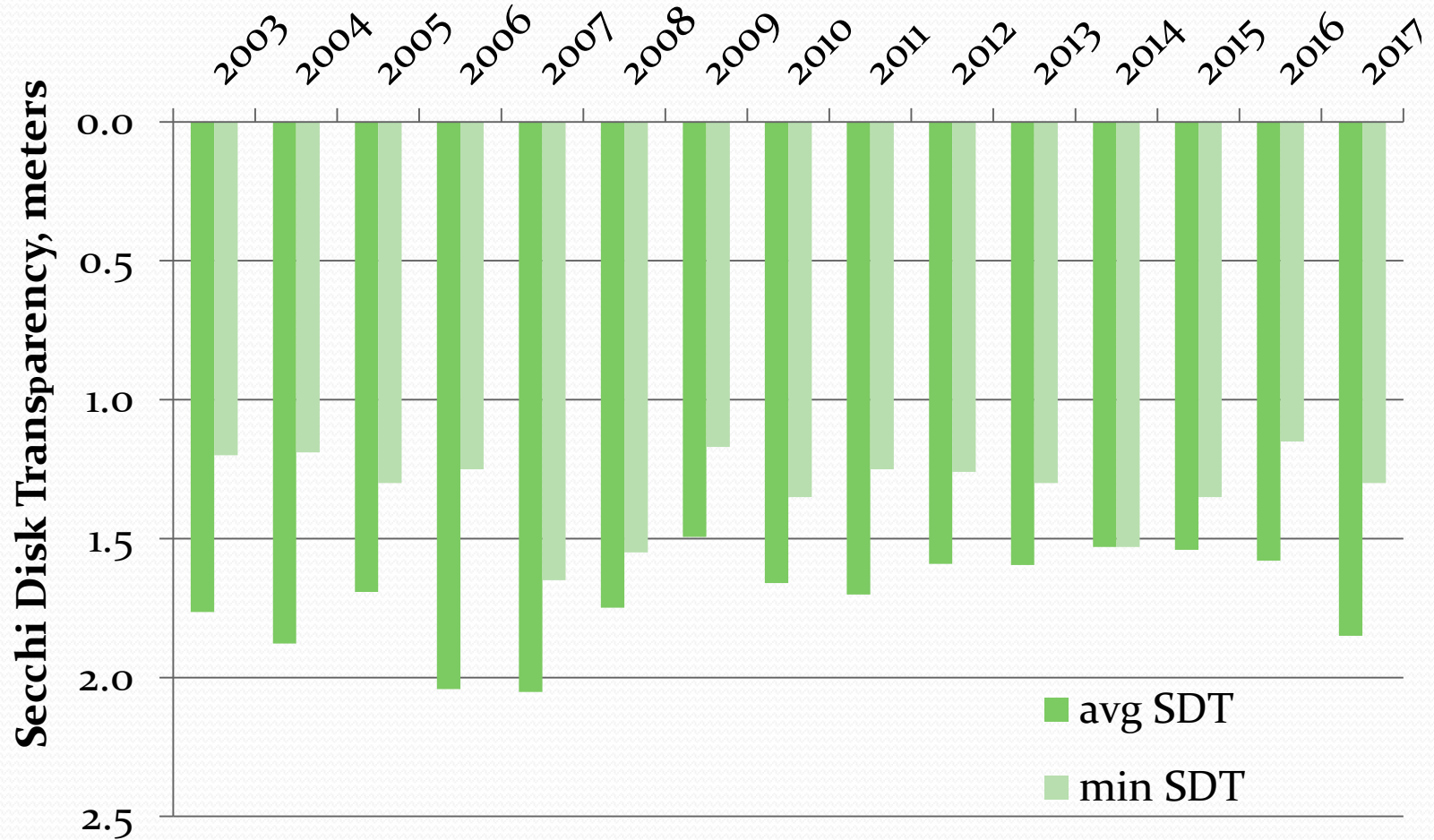
- Restoration goal: eelgrass bed expansion
- Eelgrass present when Total N less than 0.45 mg/L
- MEP model estimated the current N load, the N load to achieve 0.45 mg/L, and allocated load reductions across sources (TMDL)
- Salt Pond in Eastham is among the sentinel monitoring stations for Nauset (site 038)

# TMDL Nitrogen Target: 0.45 mg/L

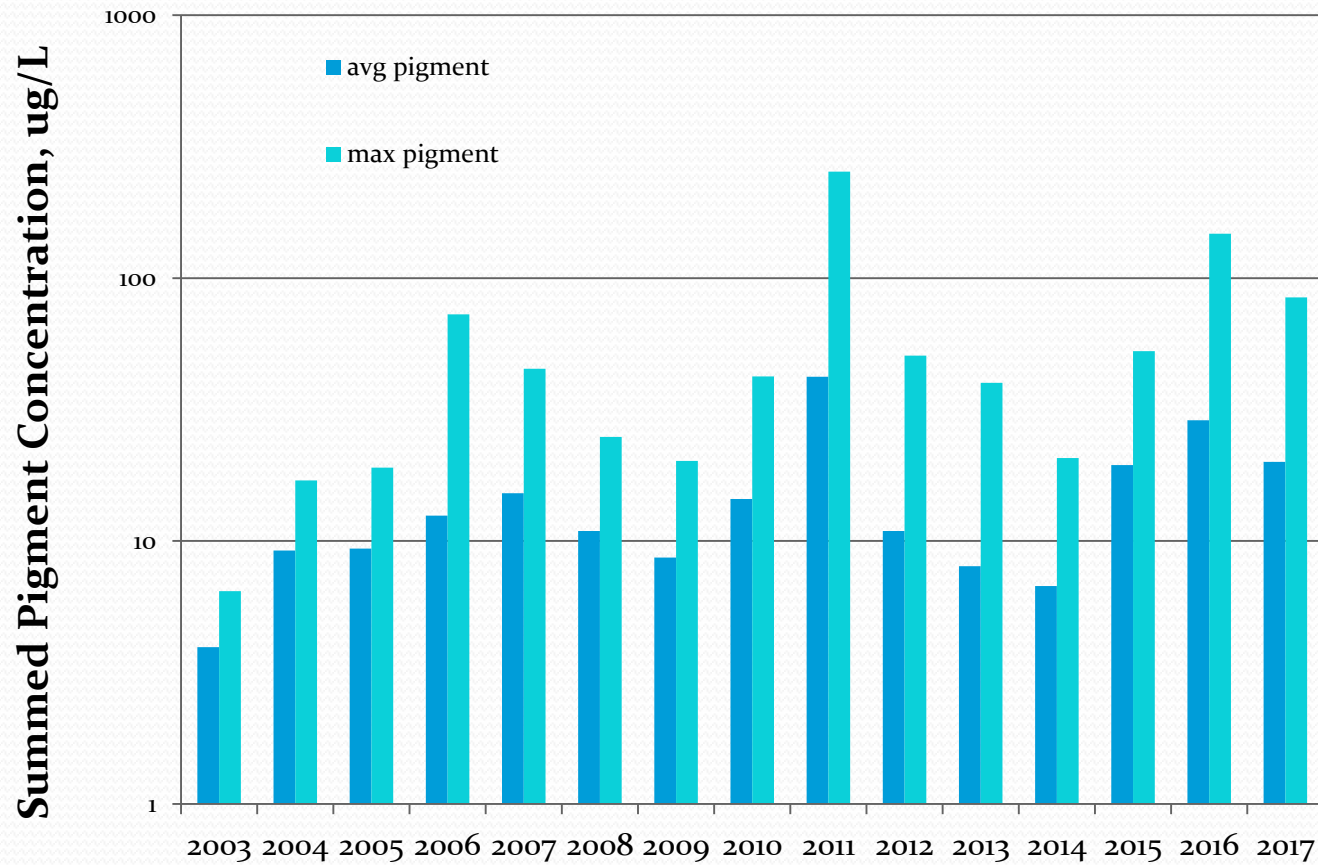
**Salt Pond: Total N Status**  
*Average compared to Target*



## Salt Pond: Water Clarity Status

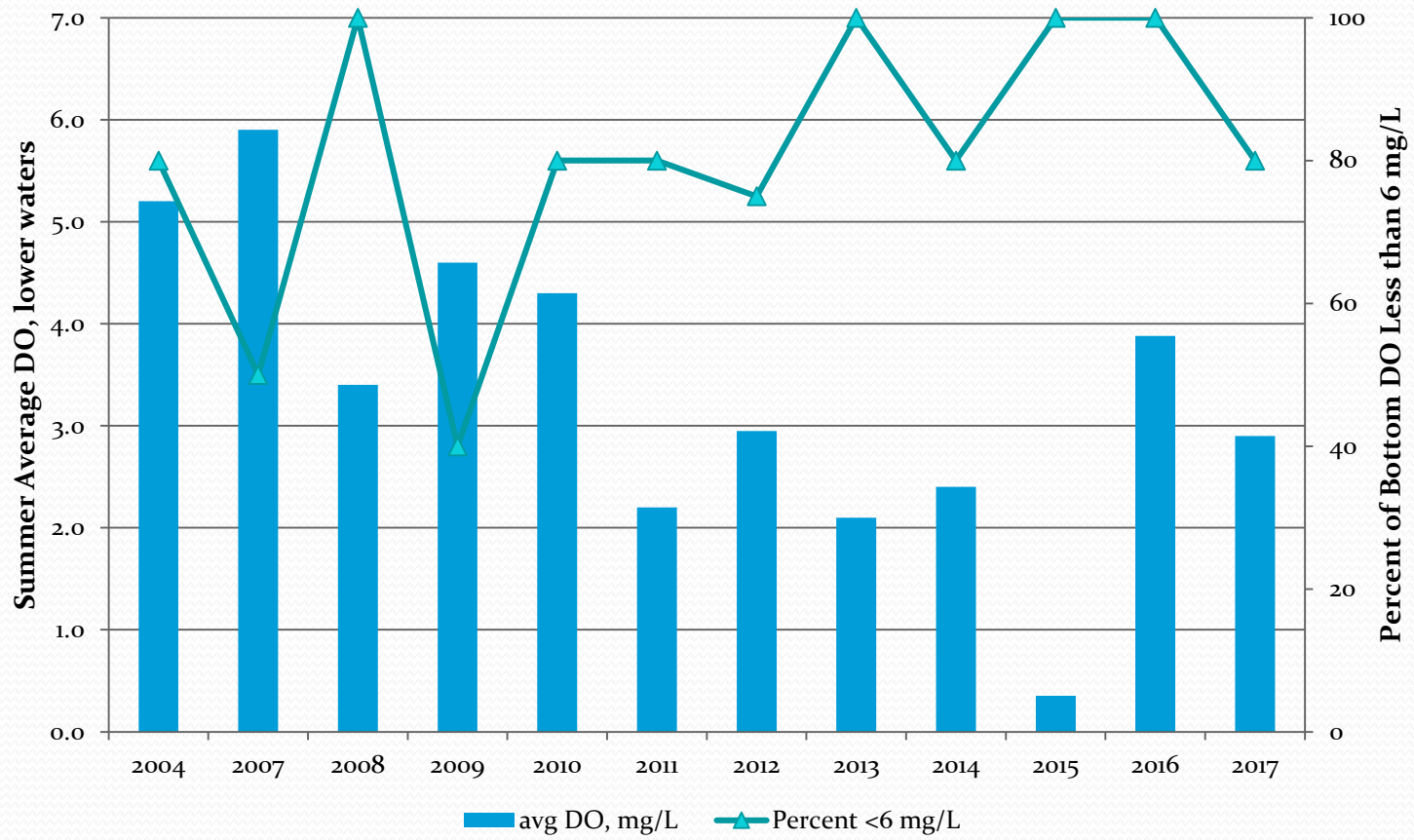


## Salt Pond: Algal Pigment Status





## Salt Pond: Deep Water Dissolved Oxygen Status



# Status Update

Minister/Schoolhouse Remedial Measures

# 2017 SŌLitude Program

- Plant survey (June 7, 2017)- 17 species, all native
- Water quality survey (2 locations, upper waters of deep basins)- consistent with previous data
- Detected stands of invasive *Phragmites*

# 2018 SŌLitude Program

- Continued monitoring to understand nutrient dynamics
  - Water quality monitoring, both basins, 2 depths
  - Macrophyte survey later in the season
- Treated shoreline *Phragmites*
- Tested bottom sediments for forms and concentration of phosphorus
- Estimated macrophyte rooting depth

# Sediment Phosphorus and Chemical Forms

Pond	Total P (mg/kg dry)	Iron-bound P (mg/kg dry )
Minister (2018)-deep	989	185
Schoolhouse (2018)-deep	2,202	408
Great (2013)	14,717	20
Herring (2012)	74,233	789

# 2018: Major Findings

- Narrow littoral zone supports nuisance levels of native macrophytes, interfering with recreational access
- Elevated chlorophyll-a concentrations diminish aesthetic appeal
- Relatively shallow organic layer overlies sandy bottom; macrophyte rooting depth restricted to upper 4 – 6 inches
- Sediments contain low to moderate concentrations of available P

# SŌLitude Recommendations

- Phase 1: 2019
  - Hydroraking to address excessive macrophytes
  - Aeration to address oxygen depletion
  - Continue treatment of *Phragmites*
- Phase 2: 2020
  - Possible alum treatment program to address sediment phosphorus flux

# Discussion

